TDGMM: A stable transient integral equation that is locally flexible in choice of basis and geometry order

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Method of Moment solutions to integral equations traditionally proceed by first defining a tesselation of the scatterer surface, followed by defining a basis set which is closely tied to this underlying tesselation. This greatly restricts the space of basis functions that can be used in the numerical solution of a given problem. In [N. V. Nair et al., IEEE TAP, 59, 2280, 2011] a Generalized Method of Moments (GMM) framework was introduced, which permitted the use of multiple basis function types within the approximation space. Recently, this method has been used with locally smooth approximations to the scatterer surface [N. V. Nair and B. Shanker, JASA, 1261, 2012]. Starting from a either point cloud or a flat tesselation, smooth approximations to the surface are obtained on the fly to accurately represent the scatterer geometry. In addition, this methodology has been adapted to permit a range of other basis functions including RWG and GWP basis function, on *locally* adaptive surfaces with varying geometric order [D. D. Dault and B. Shanker, APS, 2013]. This freedom in both the approximation space and the geometric representation can open avenues towards hp-adaptivity.

In this work we will present an effort to extend GMM to the time-domain. Historically, time-domain integral equation solvers have faced two major challenges, computational complexity and instability. While the former has been fairly well addressed by the development of fast solvers [A. A. Ergin et al., IEEE AP Mag., 41, 39, 1999; A. E. Yilmaz et al., IEEE TAP, 52, 2692,2004], instability remains an open problem. Over the past two decades, significant progress has been made in developing stabilization schemes. Perhaps most promising have been the quasi-exact integration schemes [B. Shanker et al., IEEE TAP, 57, 1506, 2009; Shi et al., IEEE TAP, 59, 574, 2011], in which matrix elements are handled by analytically evaluating retarded potential integrals. These schemes, however cannot be extended to higher order meshes. It was this motivation that prompted the work of [A. J. Pray et al., IEEE TAP, 60, 3772, 2012], in which a separable expansion in space and time of the retarded potential was used to accurately evaluate matrix elements in a purely numerical fashion. However, this approach is not higher order convergent in time. To facilitate this, we will invoke in Galerkin testing in time [A. J. Pray and B. Shanker, APS, 2013] as well as space within the GMM framework. At the conference, we will present results to verify the overall stability and accuracy of the method.